AN EVALUATION OF THE TRIAGE OF VICITMS OF MASS CASUALTY INCIDENTS IN SEMINOLE COUNTY, FL

EXECUTIVE ANALYSIS OF FIRE SERVICE OPERATIONS IN EMERGENCY MANAGEMENT

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

The Seminole County EMS System (SCEMSS) utilized the START triage to sort and transport victims of a mass casualty incident. The problem was that the SCEMSS did not triage victims or manage the disposition of them efficiently. The purpose of this paper was to determine the weaknesses of the current system and evaluate other triage methods for advantages. This research attempted to answer:

1. What are the weaknesses of the current triage system used by the SCEMSS?
2. How well do county emergency responders understand their current system's weaknesses?
3. What other triage methods are used by emergency responders?
4. What improvements can be made to improve triage in Seminole County?

Evaluative method was used through survey and system evaluation. Results confirmed weaknesses and offered recommendations for improvement including evaluation of the SACCO Triage Method.

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Introduction

Although The City of Winter Springs has not had a major mass casualty incident, fire department emergency responders had been trained in the use of the Simple Triage and Rapid Transport (START) triage method. The Sanford-Orlando Airport, located in north Seminole County, sponsored a triennial disaster drill that all of the fire departments in the county participated in. As an evaluator of the emergency medical services (EMS) triage, treatment, and transport segment of several drills, the author of this research paper observed unsuccessful implementation of rapid triage and transport of injured victims.

The problem is that Seminole County EMS system, which the Winter Springs Fire Department is part of, does not accurately triage victims or manage the disposition of them efficiently.

The purpose of this paper is to determine the weaknesses of the current triage system and evaluate other triage methods for advantages and potential implementation by the Seminole County EMS system (SCEMSS). This research will attempt to answer these research questions:

1. What are the weaknesses of the current triage system used by the Seminole County EMS system?
2. How well do Seminole County emergency responders understand their current triage system's weaknesses?
3. What other triage methods are being used by emergency responders around the world?
4. What specific improvements can be made to improve triage in Seminole County?

Evaluative research will be used to assess the current triage system through literature review, system assessment, and responder survey, as well as assessing other triage methods through literature review in order to make recommendations to the Seminole County EMS system.

Background and Significance

The City of Winter Springs is a 15 square mile suburban bedroom community, with a medium to upper class population of approximately 32,000 located about 15 miles north of Orlando, Florida (State & County Quickfacts, 2000). The city consists of mostly residential property, but is growing commercially due to the development of a "town center" that will be comprised of both retail and residential occupancies. The City of Winter Springs Fire Department (WSFD) is comprised of more than 50 career firefighter/EMTs, and is one of 7 municipal fire departments in Seminole County that work together as a result of first response agreements and a single county emergency dispatch center. The WSFD placed 3 fire engines and 2 medium duty ambulances, all with Advanced Life Support (ALS) capabilities, across 3 strategically located fire stations throughout the city.

Seminole County is currently twelfth in population as compared to Florida's 66 other counties. With a relatively small geographic area, approximately 308 square miles, and a population of 392,000, Seminole County is becoming increasingly urban in character (State & County Quickfacts, 2000).

All SCEMSS agencies are given the opportunity to participate in a one-day triennial mass casualty drill held at the Orlando-Sanford Airport with the SCEMSS goal of evaluating the execution of the adopted triage system, START, which stands for

"Simple Triage and Rapid Treatment". Field application of the adopted triage system does not appear to provide the level of care expected by the SCEMSS management alliance. The SCEMSS may not be prepared to manage victims efficiently enough to maximize victim survival in the event of a major mass casualty incident in Seminole County.

Literature Review

Sacco, Navin, Fiedler, Waddell, Long, and Buckman (2005) stated that START Triage was the most widely used triage method, and was developed by Hoag Hospital and the Newport Beach California Fire Department in the 1980s. The goal was to do the greatest good for the greatest number of people. The concept of triage is simply a method of quickly identifying victims who have immediately life-threatening injuries AND who have the best chance of surviving so that when additional rescuers arrive on scene, they are directed first to those victims. The START system, as well as other triage systems, uses objective physiological RPM criteria which takes less than a minute for the emergency responder to sort victims into one of 4 categories: immediate, delayed, expectant, and ambulatory, thereby reducing the emotional aspect even when the best emergency responder is easily overwhelmed when faced with multiple victims who all need emergency care (START, n.d.). Sacco et al. (2005) states that "immediate" (red tag) victims are deemed to be critically injured and require immediate intervention, "delayed" (yellow tag) victims are injured but not expected to die within the first hour if care is delayed. "Expectant" (black tag) victims are those who are presumed deceased or have catastrophic injuries, and survival is not expected, and "ambulatory" (green tag) victims can walk and are presumed not critically injured.

START guidelines inform the emergency responder to assess the victim's respirations first to determine if they are above 30 breaths-per-minute. If they are, the responder tags the victim as immediate and moves on to the next victim. If not, the responder assesses perfusion. If that value is out of range, the victim is tagged immediate, and the responder moves on. RPM is not assessed on every victim (START, n.d.).

Doing the greatest good for the most victims involves more than just deciding who would get transported to a hospital first. In order to maximize the number of mass casualty survivors, efficient use of all available resources is critical involving coordination with regional emergency response agencies and hospitals. In an online book entitled *Disaster Response: Principals of Preparation and Coordination*, Auf der Heide (1989) stated that in many disasters studied, a majority of disaster casualties were sent to the closest hospital overwhelming its resources. In one study, not only did the closest hospital receive the most number of victims, but also those most seriously injured. Nocera and Garner (2000) stated that this resulted in merely relocating the disaster from the scene to that hospital. "Hospitals must have triage systems to cope with potential incidents in close proximity of their facility where a large number of casualties can present without warning before an emergency medical system response has been initiated" (Nocera & Garner, 2000). Auf der Heide (1989) expressed that in one study, slightly less than half of the casualties arrived at the hospital by properly equipped ambulance or rescue vehicle and that there was a tendency for police officers to load victims into whatever vehicles were handy and send them to the hospital. This contributes to two problems: 1) Casualties with relatively minor injuries arrive before those with serious conditions inundating the emergency room and occupying valuable beds. 2)

Casualties arrive at the hospital without being triaged or having received stabilizing medical treatment.

Auf der Heide (1989) suggests that there is no single, standard, or universal method of triage. The number of triage categories a victim may be designated vary from two to five or more, depending on the particular triage system in use. There are various color codes, numbers, and symbols used to identify these categories. The triage category is often designated by the use of a triage tag which may differ between agencies. If tags are not used, a symbol is sometimes marked on the victim. Nocera and Garner (2000) stated that after the 1989 crash of a Boeing 737-400 in Kegworth, UK, the three counties that responded were confused due to the use of different triage systems and triage tags. Sideras (n.d.) stated that in his EMS system, there are five uniquely different styles of triage tags, and that different tags can lead to confusion on the scene.

Triage is not used enough to be proficient at it. It is possible that many agencies' first complete execution of their triage system occurs during an actual mass casualty incident due to minimal simulation training, be it tabletop, functional, or full-scale exercises. Nocera and Garner (2000) stated that experience has shown that the key operational principal for an efficient disaster response is to ensure responders exercise as near as practical to their normal daily routines. They go on to say that exercises must be based upon what people are likely to do in the stress of a mass casualty incident (MCI) and procedures should be kept simple and practical.

Sideras (n.d.) suggested that emergency responders may have difficulty with the recollection of the proper usage of triage tags. His solution was to direct his EMS system to practice triage tag usage at least weekly, calling the training "triage Tuesday" by

having all victims, not just trauma victims, triage tagged on Tuesdays. Local hospitals that received transported triage tagged victims would also become familiar with the local triage system.

START triage results in inconsistent victim triage. In a 2003 Pennsylvania Department of Health tabletop exercise where participants were grouped into 70 separate teams originating from all over the state, were required to use their current triage protocols, most of them used START, to tag victims as red (immediate), yellow (delayed), green (ambulatory), or black (expectant). Navin and Waddell (2005) witnessed a wide variation in the way that the teams categorized the victims indicating a complete lack of consistency. In the exercise the distribution of victims, if they were tagged according to standard START protocol, would have totaled been 25 red (immediate) and 20 yellow (delayed). Results of the drill showed the total number of red tagged victims ranged between 4 and 44, and yellow tagged victims ranged from 1to 20. Even though there were no planned green or black tagged victims, the total of green (ambulatory) tagged victims ranged from 0 to 29 and black (deceased) from 0 to17. In one case, a victim deemed a red by one team was tagged as a black by another team. Navin and Waddell (2005) stated “as a victim, you get one triager and you go immediately to the hospital. Get a different triager, and you’re deferred on the scene. Triage should not be luck of the draw”.

Nocera and Garner (2000) explained that doing the greatest good for the most victims involves maximizing the number of possible survivors. The success of the triage process as a means of minimizing preventable deaths during an MCI depends on being able to rapidly identify those casualties close to dying and to not focus resources on them.

When attempting to decide which victim should be transported to the hospital first, many emergency responders choose the worst injured to go first. As stated previously, it is difficult to rapidly determine the most severely injured victims from the triage tag applied by another responder. Once determine, the worst-first strategy for victim transport is neither an efficient use of limited on-scene resources, nor does it does it increase victim survivability. Sacco et al. (2005) stated that "The commitment of resources to victims with small survival probabilities delays treatment to others more likely to survive. Consequently, the latter victims may deteriorate."

There are other triage systems available for the prehospital setting, many that assess the common respirations, perfusion, and mental status (RPM) criteria but utilize a different triage tag system, and some that use different, or additional criteria to sort the level of criticality of trauma victims. Although this list is not all inclusive, some other triage systems include:

- Triage Sieve, a system used in the UK that is very similar to START where the emergency responders use RPM to initially assess and triage tag the victim. Triage Sort is used secondarily to reassess the victim utilizing the Triage Revised Trauma Score (TRTS) which is comprised of the Glasgow Coma Score (GCS), respiratory rate, and systemic blood pressure as criteria to further quantify the severity of the victim's condition. (Mark, n.d.)
- SmartMCI also originated in the UK and uses the START assessment criteria but a different triage tag. The tag is more visible from a distance allowing responders to make decisions with an overall bigger picture of the scene (TSG Associates, n.d.).

- The Homebush Triage Standard, developed in Australia, takes in consideration that not all MCI occur in close proximity of hospitals. Limited resources in isolated regions and long transport times dramatically reduce the threshold of what constitutes an MCI and creates unique difficulties in managing those incidents. (Nocera & Garner, 2000)
- In situations where casualties must remain on scene for prolonged periods of time, such as after a catastrophic earthquake, triage must be handled differently. Often there are multiple scenes in addition to damage to the infrastructure. Available resources may be limited and time to definitive care may be uncertain. Some incidents evolve over hours or even days. Mass Disaster Response (MDR) is a system that combines START as an initial triage method and Secondary Assessment of Victim Endpoint (SAVE) to direct limited resources by factoring in pre-existing diseases and age into triage decisions. (Benson, Koenig, & Shultz, 1995)
- The SACCO Triage Method (STM) is a unique concept that addresses many of the problems that currently exists with triage systems used around the world. Sacco et al. (2005) states that it is evidence based and offers a prediction of how many victims may actually survive. Predicting the number of potential survivors is unique to the STM that benefits not only to the victim, but also to EMS managers in that there is a defined measurement that can be utilized to determine the triage abilities of their personnel. Sacco states that in order to maximize expected survivors, we need predictions of survival probability and changes in survivability over time.

Sacco et al. (2005) states that the START triage strategy is to treat the most severely injured victims first, then the moderate, and then others as possible. First,

determining who is injured worse is difficult in the field setting under the stress of an MCI. Second, it may not be logical to send the most severely injured to the hospital first if they are close to death. Responders may save more victims by transporting those slightly less injured, or that have a better prognosis for survival. The STM uses the same RPM assessment criteria that many other systems use, but instead of only three categories, the victim is assigned a numerical value between 0 and 12 further defining the severity. This takes a few seconds longer but the values can be used in a formula developed by ThinkSharp, Inc. to efficiently provide recommendations to on scene responders for treatment and transport decisions that will maximize the number of total survivors. The recommendations come in the form of a plan that takes in consideration the number of victims in each numerical value, the number, type and distance of each hospital from the scene, and the vehicles and helicopters available for transport to the hospitals. Basic information is entered into either on a computer at a communications center, on a laptop at the scene, or on paper if no computers or radio contact is available to the communication center, and a total victim management plan is laid out in a matter of minutes. Sacco et al. (2005) advises that it identifies the number of victims with each value and each time period to be transported and/or treated, such that the expected number of survivors is the maximum possible, given limitations on resources. This method provides solutions quickly even for mass casualty situations and can be recalculated from time to time in response to scene and resource changes. Knowing that the system is slightly more complicated than other triage systems, the STM is designed to be used on a daily basis by emergency

responders on routine calls providing ample practice and reassurance in the use of the system on an MCI.

- JumpSTART is a pediatric version of START that provides a rapid triage system specifically designed for children, taking into consideration their unique physiology. It uses slightly different assessment criteria adapted for victims between the ages of 0 to 8, including those with special needs. START requires a response from an adult victim after being given a command. Obeying commands may not be an appropriate gauge of mental status for younger children. Best of all, it provides objective triage criteria that will provide emotional support for triage personnel forced to make life or death decisions for children in the mass casualty incident (MCI) setting (Romig, n.d.).
- The Paediatric [sic] Triage Tape is use in the UK to manage the same issues as does JumpSTART. Hodgetts, Hall, Macinichie, and Smart (1998) states that the waterproof tape relates the child's length to age related changes in normal physiological values and can be used in conjunction with any existing triage tag system. It will decrease the desire to treat all children as a high priority.

Procedures

Literature Review

A search for literature was done using the National Fire Academy's Learning Resource Center (LRC) and the internet using the search engine "www.google.com" yielding articles from periodicals and journals relating to "triage" and "mass casualty incident" as key search terms. Only one EFO abstract was found relating to the topic of triage.

Questionnaire

A questionnaire (Appendix A) was developed to assess the perception of Seminole County emergency responders regarding the use of their own agency's current triage system.

A pilot test of the questionnaire was conducted at Winter Springs station 24 in January 2006. The emergency responders participated in the test questionnaire and provided feedback on questionnaire content and style. The sample group was selected to be all of the responders in Seminole County as of January 2006 and was estimated to be approximately 400. The questionnaires were distributed to the EMS Division representatives from each of the six municipality fire departments, and one county fire department, in Seminole County at the January EMS Group monthly meeting. Verbal instructions were given to each group member regarding the due date and methods of return. No attempt was made to identify the specific department the questionnaires were returned from. A total of 198 questionnaires were returned for an overall return rate of 49.5 assuring a 95% confidence level as shown in the EFOP Applied Research Self-Study Course Student Study Guide (National Fire Academy, 2004).

The questionnaire included questions that would elicit the opinions of Seminole County responders regarding the use of their current triage system and included a cover letter explaining the purpose as well as contact information (Appendix B).

The number of years in emergency services was used to evaluate the experience the responder might have, as well as the rank or position. It was assumed that a responder with a greater number of years would have had more opportunity to have been involved with a MCI and to have used the triage system.

Question #1 was asked to determine when, if ever, the responder had used the agencies triage system on an actual MCI and not just in training.

Question #2 was to get the opinion of the responder's proficiency in the use of their agency's triage tag.

Question #3 was to get the opinion of the responder's proficiency in the use of their agency's triage system.

Question #4 was used to determine if their agency regularly trains with their current tag. The author of this research assumed that more training would mean more proficiency.

Question #5 was asked to see if the responder had actually worked in an actual MCI triage system command position. The author assumed that the more years a responder had with an agency, the more positions they would have experience in.

Question #6 was asked to determine if the responder felt that victim's transport dispositions were being managed properly under their current triage system.
A brief scenario that actually may occur was presented to the responder.

Question #7 was asked to determine under the conditions of the scenario, if the responder felt that they would be able to choose the order by which victims would be transported.

Question #8 was asked to determine the potential survivability of victims in the previously described scenario.

Question #9 was used to determine if the responder felt a triage system that could provide potential survivability of MCI victims would be a benefit to them.

Question #10 was used to determine if the responder felt that a triage system that could potentially assist on scene with victim transport disposition would be a benefit to them.

The data from the questionnaire responses was transferred to a single document for interpretation of the results (Appendix C).

Triennial Airport Drill

On February 7, 2006, a triennial mass casualty drill was held at the Orlando-Sanford Airport in Seminole County with all agencies participating with at least one emergency response vehicle and crew, either an engine or an ambulance, some provided both.

The drill was designed by Sanford-Orlando Airport management as required by the Federal Aviation Administration. The scenario emulated a runway collision of a Boeing 727 commercial jet with 50 passengers on board and a Gulfstream IV (G4) jet. There were immediate hazards to include fire and terrorist involvement. An actual out-of-service Boeing 727 jet was utilized as a prop, as well as a simulated G4 provided by the United States Navy capable of providing live fire fueled by liquid propane gas burners that were controlled by trained personnel.

The author of this research took on an active role in the design of the EMS segment of the drill by providing 100 EMT and paramedic students as acting victims for the drill with accurate injuries reflective of the scenario.

Several months prior to the drill, the SCEMSS changed triage tags from the California Fire Chief's Association original tags to the DMS Medical All Risk triage tag, both can be referenced at on the California Fire Chief's web site (California fire Chief's,

n.d.). Each agency was also asked to initiate a training review with their responders of the triage procedures including using the new triage tag prior to the airport drill held on February 7, 2006.

On the morning of the drill, participating responders were instructed to use the triage tags to document:

- Initial triage color
- Initial RPM value
- Victim number in the patient name field
- Provider impression of injury
- All vital signs including time stamp
- Any treatment provided or simulated including time stamp
- Hospital destination chosen
- Time of transport
- Mode of transport including ambulance or helicopter name or label

The responders and hospitals were informed that all of the triage tags would be collected from the hospitals after the drill for statistical evaluation by the author of this research.

Also on the morning of the drill, 100 student victims were assigned a laminated card (Appendix D) with signs and symptoms related to specific injuries that could occur in the type of incident designed for the drill. Each card provided the specific injury and 3 values for RPM, B/P and pulse that would reflect the physiological decline in condition if the victim was not treated in a realistic timeline. The drill victims were instructed to change their vital signs from the first set of vital signs to the second if they were not treated in 15 minutes after being triage tagged, and then to the third set if 30 minutes had

passed. If appropriate treatment were provided, the drill victims were instructed to return to the previous set. This, in theory, would provide the emergency responder a potentially more accurate victim condition. The drill victims were coached on how to act with the assigned injury signs and symptoms by Seminole Community College EMT-B and EMT-P instructors after being moulaged by the Seminole County Community Emergency Response Team (CERT).

The drill victims were divided into four duplicate groups, each with the exact same number and type of injuries (Appendix E). Four local hospitals participate in the drill by accepting drill victims so that they could also evaluate their own emergency plan. Each hospital was to receive one of the four groups to treat appropriately.

All four groups of victims were combined into one and randomly distributed between the Boeing 727 and an open field nearby spanning approximately 50 to 125 yards from the Boeing 727 to simulate what emergency responders may encounter after a runway collision.

Upon commencement of the drill, each victim was to be located, triaged, and tagged using the approved triage tag by arriving emergency responders under the charge of the designated triage unit leader. Victims were then to be moved from where they were found to an area designated for victim treatment under the charge of the assigned treatment unit leader, and then to an area designated for victim transport under the charge of the assigned transport unit leader. Once triage was completed, treatment provided, and the hospital destination and transportation mode was decided and documented by the appropriate responder, the victim was placed in a pre-designated bus for group transport to one of the four hospitals. This method was selected to prevent the chance that hospitals

would not receive their allotment of victims needed to satisfy the hospital's required American Health Care Association (AHCA) emergency preparedness exercise. An ambulance followed each bus to the hospital and was instructed to transfer drill victims on a time delay of approximately 5 minutes each, from the bus to the emergency room on their ambulance stretcher, providing a more realistic simulation for that hospital.

The author selected the evaluators, three members of the SCEMSS medical direction team, and provided evaluation criteria via the provided overall medical evaluation form (Appendix F). Each evaluator was instructed to review the evaluation form prior to the drill and to use a note pad to take notes regarding the drill with emphasis on performance evaluation and not completing the form. At the conclusion of the drill, each evaluator was instructed to complete the written evaluation form and submit it to the author of this research for review.

Assumptions and Limitations

This research was limited by a number of factors and assumptions. The first assumption was that all questionnaire respondents understood their own triage system and triage tag procedures.

The second assumption was that all respondents answered the questions honestly to reflect the current status of their triage system.

Evaluation processes of the airport drill led to probable bias. Although the evaluators were brought together prior to the drill to discuss expectations and evaluation criteria, the variance of levels of education and expectation resulted in probable differences of judgment.

Definition of Terms

GCS-A scale for measuring level of consciousness, especially after a head injury, in which scoring is determined by three factors: amount of eye opening, verbal responsiveness, and motor responsiveness (Free medical dictionary).

Moulage - The art of applying mock injuries for the purpose of training Emergency Response and other medical and military personnel. Moulage may be as simple as applying pre-made rubber or latex "wounds" to a healthy "victim's" limbs, chest, head, etc., or as complex as using complicated makeup and theatre techniques to provide elements of realism (such as blood, vomitus, open fractures, etc.) to the training simulation (Wikipedia, n.d.).

SCEMSS - An EMS management alliance that consists of all municipal and county fire agency responders that work under the guidance of a single EMS medical director. The SCEMSS strives for consistency in victim care throughout the county by offering analogous EMS training as well as monthly meetings with the medical director.

Triage - the sorting of and allocation of treatment to victims and especially battle and disaster victims according to a system of priorities designed to maximize the number of survivors (Merriam-Webster online).

Results

Research question #1

What are the weaknesses of the current triage system used by the Seminole County EMS system? Research shows that one of the weaknesses of START Triage is that there is no defined method to determine the most advantageous transport destination and method to the hospitals. After an initial early assessment by radio or cellular telephone to determine how many victims a hospital can accept, it is up to on scene

personnel to determine the combination of victims and severity to load on an ambulance to be transported to a hospital. Situational changes that occur on scene and at hospitals are difficult to quantify under the stress of an MCI (Auf der Heide, 1989). Nater, an airport drill evaluator, stated that there was no tracking of victims to air and ground transports.

During the triennial airport drill on February 7, 2006, it was observed by Nater, in his overall medical drill evaluation, that not everyone was using the same triage tags even though it was assumed that all of the agencies in Seminole County trained with the newer triage tags prior to the drill. It was also observed that some of the victims were never initially triage tagged and arrived at the hospital still untagged. Wechsler, in his overall medical evaluation, stated that not all of the emergency responders had triage tags with them as they assessed trauma victims. Rescuers would stop and do a 30 second assessment and move on to another victim without documentation left with the victim they assessed. This would produce a second assessment by another rescuer at a later time, consequently wasting extra time.

There are no tools available to assist emergency responders at predicting the potential number of survivors from an MCI. Sacco et al. (2005) states, “To maximize expected survivors, we need predictions of survival probability and changes in survivability over time.”

There are no procedures in place across Seminole County that mandates regular practice with triage tags or triage system that assures proficiency among emergency responders. Sideras (n.d.) states that MCIs are rare, and even simple tasks of locating triage tags and correctly triaging victims can prove to be a problem.

The author of this research attempted to quantify the results of how each victim was triage tagged by emergency responders based on predetermined injury signs and symptoms. The goal was to compare each of the four groups as described in the procedure section of this paper and determine how consistent the initial assessment and triage tagging was accomplished between groups. The author was unable to obtain enough triage tags from the hospitals after the drill because too many victims arrived with no tag. The tags that were obtained did not have enough information documented on them to be statistically significant.

The Overall Medical Evaluation that was completed by the three EMS airport drill evaluators after the drill and was collected by the author of this paper. Lists of the responses are in Appendix G.

Research question #2

How well do Seminole County emergency responders understand their current triage system's weaknesses? The questionnaire revealed that the average number of years in emergency services was 14. Rank and position varied and had no statistical significance.

Question #1 revealed that 53% of the respondents had never used their agency's triage system, 39% of those respondents had less than 10 years of experience, 38% between 11 and 20 years of experience, and 23% over 21 years of experience. Only 29% of the respondents indicated that they have used their triage system in the past 3 years. It was noted that some of the respondents indicated on the questionnaire that their indication of use of their triage system was during training or drill only and were

included as a positive use as they indicated. This factor may indicate a lower percentage of use of their triage system on actual MCIs.

Question #2 showed that 8% of the total respondents felt very proficient in the use of their agency's triage tag, 59% felt proficient, 32% felt somewhat proficient, and only 1% felt not at all proficient. Respondents that had between 0 and 20 years of experience felt that they were proficient, while between 21 and 30+ years of experienced respondents felt somewhat proficient.

Question #3 revealed similar finding as in question #2. It was assumed that many of the respondents with over 21 years of experience may be in positions less likely to be on first arriving vehicles at the scene and possible in management or supervisory positions.

Question #4 showed that 65% on the respondents do not use their triage tags during regular training.

Question #5 revealed that 71% of the respondents have never been assigned an MCI position during an actual MCI.

Question #6 indicated that 88% of the respondents felt that their triage system assured that the appropriate numbers of mass casualty victims were transported to the appropriate hospital in the appropriate ambulance or helicopter.

Question #7 indicated that 84% of the respondents could not accurately decide the transport order of victims in order to maximize survivability of those victims.

68% of the respondents to question #8 indicated that they would be able to predict the number of victims that would survive a MCI.

65% of the respondents to question #9 indicated that there was no benefit to being able to predict the survivability of MCI victims.

Question #10 revealed that 96% of the respondents felt that there would be no benefit to having a tool that would assist them in deciding the disposition of MCI victims.

Research question #3

What other triage methods are being used by emergency responders around the world? There are several triage systems utilized to manage many types of victims and special geographic locations, some are noted in the literature review section of this paper. Most use similar physiological assessment criteria with the objective to sort victims into manageable groups based on severity of injury or condition. The problem with most systems is the difficulty in assuring the consistency of the categorization of triaged victims among different emergency responders. Nocera and Garner (2000) stated that triage is approximately 70% accurate with a tendency to under estimate injury severity.

There are different methods used to tag or indicate the initial triage category of victim. Many agencies in the same region use different tags causing confusion on the scene.

Research question #4

What specific improvements can be made to improve triage in Seminole County? Sideras (n.d.) states that if there are different types of tags used in the system that additional training will be required to ensure minimum competency levels on all tags. Nocera and Garner (2000) stated that a variety of different triage systems, as well as

triage tags have been developed over the years, and that confusion can be avoided by proactively working to solve this problem.

Nater, in a response in his overall medical evaluation of the airport drill, suggests that the SCEMSS provide more training on the new triage tags as well as conducting MCI drills bi-annually. Wechsler suggested in his overall medical evaluation that the SCEMSS assure that all responders have triage tags with them at an MCI assuring that all victims are triage tagged at the scene.

Haimes, in his overall medical evaluation, suggested in his overall medical evaluation that the SCEMSS consider implementing a "litter cart" procedure and attempt to stage them at expect mass casualty locations.

At this time, the SACCO Triage Method is only one triage system available that addresses many of the problems with triage on the scene. It offers tools that would maximize the number of survivors, is measurable, reproducible, and outcome-driven. EMS performance and outcome can be evaluated. Sacco et al. (2005) states that STM uses evidence based survival probabilities, estimated deterioration rates, timing and availability of transport and treatment resources, and the number and physiology of victims to create a total victim management plan usable by one scene personnel to manage victim transport disposition. Changes in the total victim management plan can be adjusted quickly to reflect changes in resources. The STM is recommended for use on routine incidents assuring proficiency when needed on an MCI.

Discussion

Sacco et al (2005) said that the START triage system is the most widely used triage method and was created with the goal of doing the greatest good for the greatest

number of people. So how do we know that it is effective? Navin and Waddell (2005) express that triage is broken and that there is no way to know whether triage is actually effective on an MCI because the current triage strategies do not measure victim outcome. This research show that problems occur in Seminole County in just the fundamental strategies of triage, the use of the triage tags. If emergency responders do not have triage tags with them during the initial assessment of MCI victims, or do not use them as instructed, then it becomes more difficult to sort, treat, and choose a hospital destination for those victims. Consequently, the hospitals have little information from the scene that might be helpful in further victim care.

There is a disparity between the categories assigned by emergency responders when triaging MCI victims. The START triage system is inherently imprecise when different teams assess the same groups of victims, as described in a Pennsylvania study done in 2003 (Navin & Waddell, 2005). START triage, as well as other triage systems, use objective physiological criteria to sort victims into the different categories leaving the subjective emotion out of the assessment. When all three criteria of RPM are not assessed on every victim, the difference between immediate, delayed, and ambulatory categories is narrowed. The STM categorization of victims is more precise than START triage which decreases the overlap that other less precise systems yield.

MCI triage is not practiced or utilized enough to be proficient in. There have been few incidents that could be categorized as an MCI in Seminole County. An exercise every three years that involves only a select few is not enough. Navin and Waddell (2005) state that emergency responders openly acknowledge a lack of confidence in the protocol and rely on experience and judgment when making triage decisions. Research

shows that Seminole County emergency responders feel differently with a majority stating that they were very proficient to proficient with using their triage system. Proficiency was not evident during the 2006 airport drill.

Transport decisions are difficult in the field due to confusion of the MCI, disparity between categorized victims, the absence of triage tags on victims, and resource challenges evident during an MCI. Each one of these elements is a major problem on its own. There should be an easier method for disposition of victims away from the scene that would maximize survivability of the total number of victims. It should be measurable, replicable, and be amendable when any changes in resources are realized. The method should be easy to use and provide enough information to act upon by on scene emergency responders

Recommendations:

The SCEMSS should educate emergency responders on the weaknesses of the current triage system since research show that 66% of the questionnaire respondents feel that they are very proficient to proficient with their triage system. Seminole County emergency responders need to be aware that:

1. It is difficult to determining victim disposition to hospitals and to efficiently utilize on scene resources so that hospitals are not overwhelmed.
2. It is difficult to establish victim transport priority due to the disparity of categorization victims during triage. Worst-first may not be the best strategy.
3. The use of the new DMS Medical All Risk triage tag is the only acceptable triage tag instead of the older tags.

4. There is a need to exercise the triage system in order to become proficient. Recommendations from evaluators of the recent airport drill include bi-annual system drills.
5. Triage assessment should be practiced daily on routine patients.

This research suggests that the SCEMSS evaluate the SACCO Triage Method. There should be a combined effort in Seminole County prior to the recommended bi-annual drills to establish an evaluation plan to compare the STM with the current system.

If it is determined that the STM is an improvement, the SCEMSS should establish a funding plan to implement the system.

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APPENDIX A

TRIAGE SYSTEM SURVEY

Number of years in emergency services: _____ Current rank or position: _____

1. When did you last use your agencies' triage system on a mass casualty incident? (Check one)
   □ 0-6 months ago □ 6 months-1 year ago □ 1-3 years ago □ More than 3 years □ Never

2. How proficient do you feel you are at the use of your agency triage tag?
   □ Not at all □ Somewhat □ Proficient □ Very proficient

3. I feel proficient when using my agencies' triage system?
   □ Not at all □ Somewhat □ Proficient □ Very proficient

4. Does your system direct the use of triage tags daily, weekly or monthly for training purposes?
   □ Yes □ No

5. What MCI positions have you been assigned on an actual incident? (Check all that apply)
   □ Medical Branch Supervisor
   □ Triage Unit Leader
   □ Treatment Unit Leader □ None
   □ Transport Unit Leader □ Other: _____

6. In your opinion, does your agency's triage system assure that appropriate numbers of mass casualty patients are transported to the appropriate hospitals in the correct ambulance or helicopter?
   □ Yes □ No

For the next two questions, you are assigned as transport unit leader with **20** "IMMEDIATE" (RED) and **16** "DELAYED" (YELLOW) tagged patients.

7. Do you feel that you could accurately decide the transport order of those patients in order to maximize the number of patients that would survive?
   □ Yes □ No

8. Do you feel that you would be able to predict the number of patients that would survive?
   □ Yes □ No

9. If there were a triage system that could predict how many mass casualty patients could survive, would it be beneficial?
   □ Yes □ No

10. If there were a triage system that could assist the transport unit leader with what hospital patients would go and in which ambulance or helicopter, would this be beneficial?
    □ Yes □ No

APPENDIX B

QUESTIONNAIRE COVER LETTER

Dear Emergency Responder,

I am currently in the United States Fire Academy's Executive Fire Officer Program and I am working on my research paper. In the climate of today's terrorism and WMD preparedness, I am looking at the different types of triage systems used in mass casualty incidents for efficiency and ease of use in the field. Please complete the attached survey and return it to the person who distributed it to you, or fax it to: 407-327-4750.

If you have any questions, or would like a copy of my final project, email me at mbaumgart@winterspringsfl.org.

Thank you,

Marc Baumgart
EMS Division Chief
407-327-7561

APPENDIX C

TRIAGE SYSTEM SURVEY RESULTS

Average number of years in emergency services: 14

1. When did you last use your agencies' triage system on a mass casualty incident?

Yrs as a responder	% of Total	Never	0-6 months ago	6 months-1 year ago	1-3 years ago	More than 3 years ago
TOTAL		53%	5%	11%	13%	18%
0-5	21%	73%	11%	0%	11%	5%
6-10	18%	69%	6%	6%	19%	0%
11-15	18%	69%	0%	6%	0%	25%
16-20	20%	37%	0%	26%	0%	37%
21-25	11%	20%	10%	10%	50%	10%
26-30	9%	13%	13%	13%	25%	36%
30+	3%	67%	0%	33%	0%	0%

2. How proficient do you feel you are at the use of your agency triage tag?

Yrs as a responder	Very proficient	Proficient	Somewhat proficient	Not at all proficient
TOTAL	8%	59%	32%	1%
0-5	11%	58%	26%	5%
6-10	6%	75%	19%	0%
11-15	0%	75%	25%	0%
16-20	5%	63%	32%	0%
21-25	20%	20%	50%	10%
26-30	0%	37%	63%	0%
30+	34%	33%	33%	0%

3. I feel proficient when using my agencies' triage system?

Yrs as a responder	Very proficient	Proficient	Somewhat proficient	Not at all proficient
TOTAL	6%	61%	32%	1%
0-5	5%	64%	26%	5%
6-10	6%	75%	19%	0%
11-15	0%	75%	25%	0%
16-20	5%	55%	35%	5%
21-25	10%	30%	60%	0%
26-30	0%	50%	50%	0%
30+	34%	33%	33%	0%

4. Does your system direct the use of triage tags daily, weekly or monthly for training purposes?

Yes	35%
No	65%

5. What MCI positions have you been assigned on an actual incident?

71%	Reported never having been assigned an MCI position on an actual incident

6. In your opinion, does your agency's triage system assure that appropriate numbers of mass casualty patients are transported to the appropriate hospitals in the correct ambulance or helicopter?

Yes	88%
No	12%

For the next two questions, you are assigned as transport unit leader with **20** "IMMEDIATE" (RED) and **16** "DELAYED" (YELLOW) tagged patients.

7. Do you feel that you could accurately decide the transport order of those patients in order to maximize the number of patients that would survive?

Yes	16%
No	84%

8. Do you feel that you would be able to predict the number of patients that would survive?

Yes	68%
No	32%

9. If there were a triage system that could predict how many mass casualty patients could survive, would it be beneficial?

Yes	35%
No	65%

10. If there were a triage system that could assist the transport unit leader with what hospital patients would go and in which ambulance or helicopter, would this be beneficial?

Yes	4%
No	96%

APPENDIX D

VICTIM CARD

Patient number 53
Bus: Alpha
Slammed head against frame of plane

	R	P	Mental status	B/P	Pulse
1	28	>3	confused	130/100	138
2	24	>3	confused	160/120	138
3	12	>3	unconscious	190/128	140

Patient number 54
Bus: Alpha
Slammed abdomen into chair frame

	R	P	Mental status	B/P	Pulse
1	30	<2	obeys	128/76	92
2	30	<2	obeys	134/90	104
3	26	<2	obeys	140/98	118

Patient number 55
Bus: Alpha
Amputation of lower leg mid thigh

	R	P	Mental status	B/P	Pulse
1	36	<2	obeys	156/90	145
2	36	<2	obeys	150/94	150
3	34	<2	obeys	155/96	156

Patient number 56
Bus: Alpha
Fractured humerus & both femurs

	R	P	Mental status	B/P	Pulse
1	40	<2	obeys	140/100	140
2	40	<2	confused	146/102	145
3	38	<2	unconscious	146/98	148

Patient number 57
Bus: Alpha
2nd degree burns to face and chest

	R	P	Mental status	B/P	Pulse
1	28	<2	obeys	130/84	98
2	26	<2	obeys	134/84	100
3	28	<2	obeys	130/86	98

Patient number 58
Bus: Alpha
Fractured right humerus

	R	P	Mental status	B/P	Pulse
1	24	<2	obeys	140/90	96
2	24	<2	obeys	136/88	96
3	26	<2	obeys	140/86	94

Patient number 59
Bus: Alpha
chest pain

	R	P	Mental status	B/P	Pulse
1	26	<2	obeys	130/80	88
2	26	<2	obeys	134/78	90
3	26	<2	obeys	134/88	88

Patient number 60
Bus: Alpha
Dislocated knee with distal pulse

	R	P	Mental status	B/P	Pulse
1	28	<2	obeys	140/68	90
2	28	<2	obeys	136/70	96
3	26	<2	obeys	138/74	94

APPENDIX E

VICTIM COMPILATION

#		V	INJURY TYPE	R1	P1	M1	B/P1	Pls1	R2	P2	M2	B/P2	Pls2	R3	P3	M3	B/P3	Pls3
1	R	1	Blunt force trauma to the chest	32	2	obeys	132/96	110	30	2	obeys	110/80	90	16	2	confused	80/48	64
2	R	1	Penetrating trauma to the abdomen	30	2	obeys	150/100	120	30	1	obeys	110/70	100	18	1	confused	90/60	90
3	R	1	Head injury	28	1	confused	130/100	138	24	1	confused	160/120	138	12	1	unconscious	190/128	140
4	R	1	Blunt force trauma to the abdomen	30	2	obeys	128/76	92	30	2	obey	134/90	104	26	2	obeys	140/98	118
5	R	1	Amputation of lower extremity mid thigh	36	2	obeys	156/90	145	36	2	obeys	150/94	150	34	2	obeys	155/96	156
6	R	1	Bilateral fractured femurs and fractured humerus	40	2	obeys	140/100	140	40	2	confused	146/102	145	38	2	unconscious	146/98	148
7	R	1	2nd degree burns to face and chest	28	2	obeys	130/84	98	26	2	obeys	134/84	100	28	2	obeys	130/86	98
8	Y	1	fracture humerus	24	2	obeys	140/90	96	24	2	obeys	136/88	96	26	2	obeys	140/86	94
9	Y	1	chest pain	26	2	obeys	130/80	88	26	2	obeys	134/78	90	26	2	obeys	134/88	88
10	Y	1	dislocated knee with distal pulse	28	2	obeys	140/68	90	28	2	obeys	136/70	96	26	2	obeys	138/74	94
11	Y	1	laceration to face with possible vision loss	28	2	obeys	136/80	80	26	2	obeys	130/76	84	22	2	obeys	128/76	84
12	Y	1	laceration to chest with fracture ulna/ radius	30	2	obeys	140/90	100	26	2	obeys	144/92	98	26	2	obeys	142/90	98
13	Y	1	abrasions to hands and arms	18	2	obeys	122/64	88	18	2	obeys	124/68	88	16	2	obeys	128/68	86
14	Y	1	lacerations to hands	16	2	obeys	124/68	90	16	2	obeys	120/70	70	18	2	obeys	122/78	74
15	Y	1	abrasions to hands and arms	20	2	obeys	130/74	82	18	2	obeys	128/78	80	18	2	obeys	120/76	78
16	G	1	bruising to arms and legs	14	2	obeys	118/78	80	16	2	obeys	118/76	80	18	2	obeys	120/78	78
17	G	1	laceration to shins bi-lateral	16	2	obeys	120/80	76	16	2	obeys	120/78	78	16	2	obeys	116/78	78
18	G	1	1st degree burns to arms and hands	22	2	obeys	134/90	98	22	2	obeys	136/96	98	26	2	obeys	140/92	94
19	G	1	minor fractures to hands and fingers	16	2	obeys	120/80	80	22	2	obeys	120/98	80	22	2	obeys	118/96	78
20	G	1	hematoma to face	18	2	obeys	124/84	88	18	2	obeys	124/86	88	20	2	obeys	120/80	86
21	G	1	no injury at all	16	2	obeys	130/86	92	18	2	obeys	132/84	90	18	2	obeys	132/84	90
22	G	1	Amputation of 2 digits	28	2	obeys	140/88	98	26	2	obeys	138/88	98	28	2	obeys	138/90	96
23	G	1	shrapnel to arms	26	2	obeys	136/68	92	24	2	obeys	134/70	92	24	2	obeys	136/74	92
24	G	1	headache	26	2	obeys	126/70	90	24	2	obeys	124/74	90	22	2	obeys	126/76	90
25	G	1	dizziness with back pain	20	2	obeys	134/80	80	20	2	obeys	130/80	82	20	2	obeys	132/80	82

APPENDIX F

OVERALL MEDICAL EVALUATION

ORLANDO SANFORD AIRPORT
February 7, 2006

Evaluator's Name_____

1. Time exercise initiated:

2. After extinguishing the simulated fire, did ARFF personnel attend to the victims in a timely and professional manner?

3. Was the triage area established at a safe distance from the aircraft?

4. Was the triage area clearly identified?

5. What was the approximate distance victims had to be carried to the triage area?

6. Approximate time the first ambulance arrived:

7. Was there adequate room within the triage area to attend to the victims?

8. Who directed the arriving ambulances to the staging area?

9. Approximate time the first victim was brought to the triage area:

10. Were victims within the triage area placed in the appropriate position in relation to their injuries?

11. Were triage tags used appropriately? If not describe the problem(s):

12. Were there adequate litter bearers?

13. Were medical supplies adequate to meet the need?

14. What supplies, if any, was in short supply?

15. How were the DOA's handled?

16. What weaknesses were observed?

17. What principal strengths were observed?

18. Recommendations:

19. Additional Remarks_____
_____
_____
_____
_____
_____
_____
_____

APPENDIX G

OVERALL MEDICAL EVALUATION RESULTS

(A) A. Nater, (B) S. Haimes, & (C) M. Wechsler responded. Results to each question are below.

1. Time exercise initiated:

A	No response	B	9:30	C	No response

2. After extinguishing the simulated fire, did ARFF personnel attend to the victims in a timely and professional manner?

A	Yes	B	No response	C	No response

3. Was the triage area established at a safe distance from the aircraft?

A	Yes	B	Too close	C	Yes

4. Was the triage area clearly identified?

A	Yes	B	Yes	C	Yes

5. What was the approximate distance victims had to be carried to the triage area?

A	Did not record, but due to wandering of ambulatory victims, I'd estimate 100 feet to a ½ mile.	B	20-50 yards	C	No response

6. Approximate time the first ambulance arrived:

A	No response	B	09:38	C	No response

7. Was there adequate room within the triage area to attend to the victims?

A	Yes	B	Area was somewhat crowded.	C	No response

8. Who directed the arriving ambulances to the staging area?

A	No response	B	There was no staging officer designated.	C	No response

9. Approximate time the first victim was brought to the triage area:

A	No response	B	Approximately 09:58.	C	No response

10. Were victims within the triage area placed in the appropriate position in relation to their injuries?

A	Yes	B	No response	C	No response

11. Were triage tags used appropriately? If not describe the problem(s):

A	Yes	B	There were multiple problems. 1) Not everyone was using the same tags. One of the objectives of the drill was for field personnel to use the new tags. 2) A few patients were not tagged. 3) The tags contain a contamination strip that identifies if a patient is contaminated. If there was not contamination the strip should be removed. This was not done consistently.	C	No response

12. Were there adequate litter bearers?

A	Yes	B	Not initially, but towards the end.	C	No response

13. Were medical supplies adequate to meet the need?

A	Yes	B	As far as I know.	C	No response

14. What supplies, if any, was in short supply?

A	No response	B	Not to my knowledge.	C	No response

15. How were the DOA's handled?

A	I did not see any from my position outside of the aircraft. My belief is that they were tagged and left in the fuselage.	B	No response	C	No response

16. What weaknesses were observed?

A	Communications. Having responsibilities across multiple talk groups was a challenge. Another individual suggested having each sector commander and the IC have an assigned "communicator" for each non-primary talk group who is delegated the task of listening and communicating on their assigned non-primary talk group for their commander	B	1) The following sectors were never clearly established. Treatment, transport & staging. 2) There were no identifying vests for sector officers. It was difficult for EMS responders to identify who was the sector officer. 3) The triage & treatment officer requested a transport and treatment officer and was told that they were too busy. 4) There was no tracking of patient destination by the transport officer.	C	No response

17. What principal strengths were observed?

A	Excellent teamwork. Excellent commitment to completing the mission successfully. "Victims" responded best to Law Enforcement for instruction on where and how to proceed. The use of the "litter cart" that appeared to be a agricultural implement cart attached to a 4-wheel tractor was excellent and effective.	B	ARFF units did an excellent job extinguishing the fire. E41 also did an excellent job in assisting with controlling the fire and performing a search & rescue of the aircraft. One paramedic took on the responsibility of being the transport officer and assigning patients to air & ground transport.	C	No response

18. Recommendations:

A	Uniformed law enforcement should be available for ambulatory victim direction. The "litter cart: concept should be formally implemented, perhaps with multiple carts specifically staged at expected mass casualty locations.	B	1) Provide more training on new triage tags. 2) Review ICS training with officers. 3) Conduct drills bi-annually.	C	No response

19. Additional remarks:

A	No response	B	No response	C	1) Immediately after arrival of FD units, walking wounded were sent to the pavilion, but there were no chaperones to address them and keep them corralled. This ended up causing them to meander out and interfere with many scene operations later. 2) There was a delay in assigning 9N as the radio channel for EMS communications. This effectively delayed or hindered EMS operation progress. 3) Not all initial responder who went into the field behind the 727 had triage tags. They would stop and do a 30 second assessment and move on to another patient without documentation left with the patients they assessed. This would produce a second assessment by another rescuer at a later time, because there was no triage tags placed. 4) There was a significant delay in the disposition of the victims who were not walking wounded in the field behind the 727. This was because of a lack of personnel. It was nearly 45 minutes after the arrival of the first unit to the field (R41) before more personnel arrived to that field to assist R41.